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# (54) Trocar

Trokar

Trocart

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## Description

### Background and Summary of the Invention

This invention relates to a trocar, and in particular to a trocar with a retractable point to reduce the risk of injuring internal organs during use.

An increasing number of abdominal surgical procedures are being performed with laparoscopic techniques in order to avoid a large skin incision. Typically in laparoscopic surgery, a special needle, similar to the pneumoneedle described in U.S. Patent No. 4,808,168, is inserted through the skin, and used to inflate the abdominal cavity with $CO_2$. Once the abdomen is adequately dilated, the needle is removed and a rigid access tube with a larger diameter (for example 10 or 11 mm) is passed through the skin in the same location. The tube provides access for the laparoscope, a small diameter cylindrical viewing device that allows the surgeon to see inside the abdomen. To drive the tube through the skin, the surgeon places a trocar in the lumen of the tube to provide a sharp leading cutting edge.

The trocar devices presently available, for example those shown in U.S. Patent Nos. 4,535,773, 4601710 (equivalent to EP-A-0135364), 4654030, 4902280, and 4931042, typically comprise a sharp point for penetrating the skin, surrounded by a spring-loaded protective sleeve. As these trocar devices are urged through the skin, friction with the skin causes the protective sleeve to slide proximally (rearwardly). After the access tube has penetrated through the skin, there is no longer friction between the protective sleeve and the skin, and the spring urges the protective sleeve distally (forwardly) to cover the sharp point, locking the protective sleeve in position to reduce the risk of accidental puncture of the underlying organs. These prior art trocars rely on a similar principle of operation: The friction or drag on the protective sleeve as the trocar is advanced through the skin pushes the protective sleeve back to expose the sharp point. Once the access tube has penetrated the skin, the drag on the protective sleeve is reduced and the sleeve accelerates distally (forwardly) under the bias of the spring to cover the point. A significant amount of force usually must be applied to penetrate the skin (particularly the tough facia), and it is often difficult for the surgeon to determine precisely when the skin has been penetrated, and therefore the trocar may continue to advance toward the underlying organs after it has penetrated the skin. Thus, the protective sleeve must "catch up" to the moving trocar point before the trocar reaches the underlying organs.

### Brief Description of the Invention

According to this invention there is provided a trocar as claimed in claim 1 herein.

The trocar of the present invention provides a mechanism for retracting the trocar point upon penetration of the skin. Thus, the sharp trocar point begins to move away from the underlying organs upon penetration of the skin. Moreover, because of the proximal (rearward) motion of the point, the covering of the point is not dependent upon the sleeve "catching up" with the point as in the prior art trocars where only the sleeve moves. The trocar of the present invention can also provide a positive tactile signal, conveniently triggered by the retraction of the point, indicating when the trocar has penetrated the skin, so that the surgeon can stop advancing the trocar.

The trocar device of the present invention is of the type placed in the lumen of a cannula to facilitate inserting the cannula through the wall of a body cavity. The trocar generally comprises a point for piercing the wall of the body cavity, a protective sleeve mounted concentrically around the point for axial movement relative to the point, and means for biasing the protective sleeve distally (forwardly) relative to the point so that after the point penetrates the wall of the body cavity, the sleeve moves distally under the bias. The trocar of the present invention further comprises means for retracting the point relative to the protective sleeve after the point penetrates through the wall of the body cavity. The trocar device preferably also comprises means for triggering the retracting means upon the distal (forward) motion of the protective sleeve. In the preferred embodiment, the retraction of the point provides a positive tactile signal to the user that the skin has been penetrated.

Thus, the trocar of the present invention begins to retract the trocar point away from the underlying organs after the point penetrates through the skin, keeping the point further away from the organs. Furthermore, because of this retraction of the point, the point of the trocar of the present invention is covered more quickly than the point of a similar device that relies solely on the distal (forward) movement of a protective sleeve to cover the point. Finally, since the device can provide a positive signal to the surgeon when the skin has been penetrated, the surgeon knows when to stop advancement of the trocar. Thus, it is believed that the trocar of this invention reduces the risk of accidental organ puncture.

These and other features and advantages will be in part apparent, and in part pointed out hereinafter.

### Brief Description of the Drawings

Figure 1 is side elevation of a trocar constructed according to the principles of this invention;

Figure 2 is an enlarged partial side elevation of the trocar of Figure 1 (prior to use), rotated about its axis 90°, with part of its casing removed and with portions of the tip broken away to reveal details of construction;

Figure 3 is a partial transverse cross-sectional view of the trocar taken along the plane of line 3-3 in Figure 2;

Figure 4 is a partial transverse cross-sectional view

of the trocar taken along the plane of line 4-4 in Figure 2;

Figure 5 is an enlarged partial side elevation view of the trocar, similar to Figure 2, showing the trocar as it is penetrating the wall of a body cavity;

Figure 6 is an enlarged partial side elevation view of the trocar, similar to Figure 2, showing the trocar after it has penetrated the wall of the body cavity;

Figure 7 is a partial transverse cross-sectional view of the trocar taken along the plane of line 7-7 in Figure 6;

Figure 8 is a partial longitudinal cross-section view of a second embodiment of a trocar constructed according to the principles of this invention;

Figure 9 is a partial transverse cross-sectional view of the second embodiment, taken along the plane of line 9-9 in Figure 8;

Figure 10 is a partial longitudinal cross-sectional view of the second embodiment taken along the plane of line 10-10 in Figure 8;

Figure 11 is a partial longitudinal cross-sectional view of the second embodiment, similar to Figure 10, with the protective sleeve partially retracted;

Figure 12 is a partial longitudinal cross-sectional view of the second embodiment, similar to Figure 10, with the protective sleeve fully retracted; and

Figure 13 is a partial longitudinal cross-sectional view of the second embodiment, similar to Figure 10, with the obturator fully retracted.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

Detailed Description of the Preferred Embodiment

A first embodiment of a trocar device constructed according to the principles of this invention, indicated generally as 20, is shown in side elevation in Figure 1. The trocar device 20 is of the type placed in the lumen of a cannula to facilitate inserting the cannula through the wall of a body cavity, for example inserting access tube 22 through an abdominal wall. The access tube 22 comprises a cannula 24 that has an enlarged generally funnel-shaped fixture 26 its proximal end. The access tube 22 provides an entryway for laparoscopes, and other surgical instruments. As is know in the art, the access tube 22 may include means (not shown) for supplying pressurized gas to the abdomen. The access tube 22 may also include a trap-door valve at the proximal end of the cannula 24 to prevent the escape of gas through the cannula when it is not occluded by the trocar or a surgical instrument.

The trocar 20 generally comprises a handle 28, formed from two interfitting casing members 30 and 32 that are secured together with screws or other suitable fastening means. The handle 28 has a generally rounded configuration that can be comfortably gripped by the user. As best shown in Figures 2, 5 and 6, the trocar 20 has an obturator 34 extending from the handle 28. The distal end of the obturator 34 has a point 36 for piercing the wall of the body cavity.

A protective sleeve 38 is mounted concentrically around the obturator 34 for axial movement relative thereto. The protective sleeve 38 is resiliently biased distally (relative to the trocar). There are a number of suitable means for biasing the protective sleeve 38, for example, as in this preferred embodiment, the protective sleeve 38 can be biased with a spring. The proximal end of the sleeve 38 can be provided with an enlarged, generally cylindrical end section 40. A coil spring 42 can be mounted generally over the end section 40, extending between an annular flange 44 on the end section 40, and a portion of a generally bell-shaped assembly 46 (described in more detail below). The assembly 46 is engaged by raised ribs 47 on the interior of the casing members 30 and 32, which hold the assembly in place. The action of the spring 42 between the assembly 46 and the protective sleeve 38 resiliently biases the protective sleeve distally. Of course some other type of resilient biasing means could be used so long as protective sleeve 38 can retract proximally as the trocar 20 is being advanced through the wall of the body cavity, yet advance distally after the point 36 (and more specifically the cannula 24) has penetrated through the wall of the body cavity.

The trocar 20 also comprises means for retracting the point 36 of the obturator 34 relative to the protective sleeve 38 after the point has penetrated through the wall of the body cavity, thereby reducing the risk that the point will cause damage inside the body cavity. The trocar 20 preferably comprises means for triggering this retracting means upon the distal (forward) movement of the protective sleeve 38, which occurs after the cannula has penetrated through the wall of the body cavity.

The bell-shaped assembly 46 comprises a cup-shaped section 48 at its distal end, a hollow, generally cylindrical section 50, at its proximal end, and a hollow, generally tapering intermediate section 52 in between. The cup-shaped section 48 comprises at least two resilient fingers 54 attached at their distal ends generally adjacent the distal end of the assembly 46, and extending generally proximally. The proximal ends of the fingers 54 are resiliently biased radially outwardly, and are provided with beads 56, discussed below. The proximal end of the generally cylindrical section 50 abuts the casing members that form the handle, while the distal end of the cylindrical section 50 supports the spring 42 as described above. The ribs 47 engage the cylindrical section 50 to anchor the assembly 46 within the handle. The intermediate section 52 has longitudinally extending slots 58, as described below.

The portion of the obturator 34 adjacent the proximal end extends through an opening in the distal end 60 of the bell-shaped assembly 46. A generally spool-shaped cap 62 is secured on the proximal end of the obturator 34. The distal 35 end of the cap 62 has a raised annular shoulder 64 that can be engaged by the

beads 56 on the fingers 54. A coil spring 66 is mounted over the portion of the obturator 34 adjacent the distal end, proximal to the distal end of the assembly 46. One end of the spring 66 is engaged by the distal end of the assembly 46, the other end of the spring is engaged by the shoulder 64. The spring 66 thus biases the obturator proximally (with respect to the trocar). Before use, as shown in Figure 2, the beads 56 on the fingers 54 engage the shoulder 64 to hold the spring 66 in compression. A locking member 68 releasably holds the fingers radially inwardly, locking the fingers 54 in engagement with the shoulder 64. The locking member 68 is preferably flat, and slidably mounted in a slot 70 in the intermediate portion of the cap 62. A pin 72 extends through a longitudinally extending slot 74 in the locking member 68 to retain the locking member in the slot 70 in the cap 62, while permitting the locking member to move longitudinally (i.e., proximally and distally). The sides of the locking member 68 project through the slot 58 in the intermediate section 52 of assembly 46. The bottom edge of the locking member 68 has notches 76, which, when the locking member is in its most distal position (see Figure 1), receive the ends of the fingers 54 and hold the beads 56 in engagement with the shoulder 64.

The proximal end 40 of the protective sleeve 38 is sized and positioned to engage the locking member 68, and slide the locking member proximally as the protective sleeve moves proximally. The sidewalls of the end section 40 of the protective sleeve 38 are sized to engage the fingers 54, and hold the beads 56 in engagement with the shoulder 64 after the locking member 68 has been displaced (see Figure 5). Thereafter, when the protective sleeve 38 moves distally, as occurs after the cannula 24 has penetrated through the wall of the body cavity and the drag of the skin on the sleeve is eliminated, the spring 42 urges the protective sleeve distally. As the end section 40 moves distally, it releases the fingers 54 which spring radially outwardly, causing the beads 56 to clear their engagement with the shoulder 64. This releases the spring 66, allowing it to expand and urge the obturator 34 (and thus point 36) proximally, i.e., retracting the point relative to the trocar 20 (see Figure 6).

The proximal end of the handle 28 preferably has an opening 78 therein so that the enlarged proximal end 80 of the cap 62 can protrude therethrough when the obturator 34 is in its retracted position. The proximal end 80 strikes the palm of the hand of the user when the obturator 34 retracts. Thus, in addition to an audible signal from the operation of the mechanism, the retraction of the obturator 34 provides a tactile signal that the point 36 has penetrated through the wall of the body cavity, thereby alerting the user to stop advancing the trocar.

A second embodiment of a trocar device is indicated generally as 100 in Figures 8-13. The trocar 100 is similar in construction to trocar 20 of the first embodiment, and is likewise adapted for facilitating inserted a cannula through the wall of the body cavity, for example inserting an access tube 102 through the abdominal wall. The access tube 102 comprises a cannula 104 that has an enlarged fixture 106 at is proximal end. The fixture 106 comprises a chamber 108. There is an opening 110 at the proximal end of the chamber through which the trocar fits while the access tube is being inserted in the body cavity, and through which surgical instruments can access the interior of the body cavity after the access tube is in place and the trocar is removed. A trap door valve member 112, having a sealing gasket 114 is pivotally mounted adjacent the opening 110 to close the opening 110. The valve member 112 is operated by a pushbutton 116 in the sidewall of the fixture 106. The pushbutton 116 is reciprocally mounted in a sealing gasket 118, and is resiliently spring-biased outwardly by spring 120. A link 122 extends from the pushbutton 116 to the valve member 112, so that pushing the pushbutton inwardly moves the valve member 112 open, and the action of the spring 120 causing the button to move outwardly when it is released causes the valve member 112 to close.

The chamber 108 also has a Roberts valve 124, by which pressurized gas can be provided to the chamber to maintain the gas pressure in the body cavity, and thereby keep the cavity inflated to facilitate the procedure.

The trocar 100 comprises a handle 126, with a generally rounded configuration that can be comfortably gripped by the user. The handle is releasably attached to the fixture 106 so that after the trocar 100 inserts the access tube 102 in the wall of the body cavity, the trocar can be removed so that the access tube can be used to introduce surgical instruments into the body cavity. The proximal end of the fixture 106 has a funnel-shaped extension 128, with an enlarged rim 130. As shown in Figure 8, the distal end of the handle 126 has resilient fingers 132 that extend into slots in the wall of the extension 128 and have a shoulder 136 to engage the rim 130 and attach the handle 126 to the fixture 106. The sides of the handle have two pivotally mounted buttons 138 which, when depressed, push the fingers 132 inwardly, out of engagement with the rim so that the handle 126 and the fixture 106 can be separated.

The trocar 100 also includes an obturator 140 extending from the distal end of the handle 126. The distal end of the obturator has a point, like the point 36 on obturator 34. A protective sleeve 142 is mounted around the obturator 140 for axial movement relative thereto. The protective sleeve 142 is resiliently biased distally (relative to the trocar 100). In this second preferred embodiment, the protective sleeve 142 is biased with a spring. The proximal end of the sleeve 142 is provided with an enlarged generally cylindrical section 144. A coil spring 146 is mounted inside the cylindrical section 144, with its distal end supported in an internal shoulder 148 on the sleeve, and its proximal end engaging a raised shoulder on the obturator (described in more detail below). The action of the spring 146 resiliently biases the protective sleeve 142 distally. However,

the protective sleeve can move proximally against the bias, under the forces applied by the wall of the body cavity as the trocar is advanced through the wall of the body cavity, and resilient move distally when the applied forces are removed, as occurs once the cannula 104 is inserted through the wall of the body cavity and the protective sleeve is no longer in frictional contact with the wall of the body cavity. Of course as noted above in the description of the first embodiment, some resilient biasing means other than coil spring 146 could be used.

The trocar 100 also comprises means for retracting the point on the obturator 140 relative to the protective sleeve 142 after the point has penetrated through the wall of the body cavity, thereby reducing the risk that the point will cause damage inside the body cavity. In this second embodiment, the retracting means is triggered upon the distal (forward) movement of the protective sleeve 142.

As best shown in figures 10-13, there is a tubular extension 150 secured on a shoulder on the proximal end of the obturator 140. An enlarged head 152 is secured onto the proximal end of the extension 150. The extension 150 has a generally radially extending flange 154. The distal surface of the flange 154 forms the shoulder that engages the proximal end of the spring 146. There are at least two proximally extending resilient fingers 156 around the obturator. The proximal ends of the fingers 156 are resiliently biased outwardly from the obturator, and have beads 158 that can engage the flange 154 on the extension 150, and thereby hold the obturator against proximal retraction under the bias of spring 146. The distal ends of the fingers 156 are anchored to a ring 157. The ring 157 is supported on a generally cylindrical base 159, similar to the bell-shaped assembly 46 of the first embodiment.

Before use, as shown in figure 10, the beads 158 on the fingers 156 engage the flange 154, holding the spring 146 in compression and holding the obturator 140 from proximal retraction. A locking member 160, slidably mounted on the proximal portion of the extension member 150, locks the fingers 156 in engagement with the flange 154. The bottom edge of the locking member 160 has notches 162 which when the locking member 160 is in its distal most position, receive and engage the fingers 156 and hold the beads 158 in engagement with the shoulder.

The cylindrical section 144 of the protective sleeve 142 is sized and positioned to engage the locking member 160, and slide the locking member proximally as the protective sleeve slides proximally (as occurs as the trocar 100 is advanced through the wall of a body cavity and the friction of the wall acts against the protective sleeve 142). The locking member 160 has tabs on 164 on opposite sides that are trapped between and can engage portions 166 of indicators 168. The indicators are slidably mounted on opposite sides of the handle 126. There are windows 170 on opposite sides of the sidewall of the handle 126, each exposing a portion of one of the indicators 168. The indicator can have indicia at locations 172a and 172b to provide a visual indication of the status of the trocar 100. The indicia at 172a is visible through the windows 170 when the trocar is ready for use (Figure 10). The indicia at 172b is visible through the windows 170 when the trocar point is retracted, as described in detail below (Figure 13). The tabs 164 can move within the portions 166 of the indicator 168. This allows extra motion or dwell that facilitates resetting the device, as described below.

As shown in Figure 11, when the protective sleeve 142 moves proximally, it pushes the locking member 160 proximally until the tabs 164 engage the portions 166 of the indicators 168. Thereafter, further proximal movement of the protective sleeve 142 not only moves the locking member 160, but it also moves the indicators 168. The cylindrical section 144 of the protective sleeve 142 is sized to engage the fingers 156, and hold the beads 158 in engagement with the flange 154 after the locking member 160 has been displaced. Thus, as shown in Figure 12, when the protective sleeve 142 is in its fully retracted position, the locking member 160 has been moved proximally, and the walls of the cylindrical section 144 hold the fingers 156 in engagement with the flange 154. The mechanism of the trocar 100 is now primed so that any distal advancement of the protective sleeve will trigger the trocar to retract the obturator point.

When the cannula 104 pierces through the wall of the body cavity, it shields the protective sleeve 142 from contact with the wall of the body cavity, and thus the wall of the body no longer exerts frictional force on the protective sleeve. The reduction in force on the sleeve allows the protective sleeve 142 to advance distally under the bias of spring 146. As the protective sleeve advances, the cylindrical section 144 releases the fingers 156. When the fingers 156 are released, they spring resiliently outwardly, and the beads 158 clear the flange 154. This allows the obturator 140 to retract under the bias of the spring 146. As the obturator retracts, it moves the locking member 160 with it, which in turn moves the indicator so that the indicia at 172b is visible through the window 170, providing a visible indication that the obturator point has retracted. Moreover, the cap 152 protrudes through an opening 174 in the handle 126 providing an additional visible signal, as well as a tactile signal that the obturator point has retracted. A rim 176 around the cap 152 engages the periphery of the opening 174 to allow the cap 152 to protrude through the opening 174, but not pass completely through. A shoulder 178 may also be provided on the obturator to engage the a shoulder 180 on the protective sleeve 142, and limit the retraction of the obturator.

Operation

The trocar 20 is prepared for use by removing the protective cap 82 over the point. The access tube 22 is already installed over the distal end of the trocar 20. The user grasps the handle 28 of the trocar 20, with the palm

of the hand over the proximal end. The trocar 20 is advanced against the wall of a body cavity, for example the abdomen. As the trocar 20 is advanced, friction or drag from the skin urges the protective sleeve 38 proximally. As the protective sleeve 38 moves proximally, its enlarged proximal end 40 also moves proximally. The proximal end 40 of the protective sleeve 38 pushes the locking member 68 proximally, releasing the notches 76 from their engagement with the fingers 54, while the enlarged end 40 simultaneously moves over the fingers to continue to hold the beads 56 in engagement with the shoulder 64. (Compare Figures 2 and 5.) The user continues to advance the trocar, penetrating the wall of the body cavity. Once the cannula 24 has penetrated through the wall of the body cavity, the drag on the protective sleeve 38 is reduced, and the spring 42 urges the protective sleeve 38 distally. The distal motion of the sleeve 38 also causes the enlarged end to move distally, releasing the fingers 54. The fingers 54 spring radially outwardly, releasing beads 56 from their engagement with the shoulder 64. This allows the spring 66 to expand, pushing the obturator 34 proximally. (Compare Figures 5 and 6). Thus the point 36 begins to move proximally, i.e., it retracts. The proximal motion of the point 36 causes the point to be quickly surrounded by the protective sleeve. As the obturator retracts, the proximal end 80 of the cap 62 projects through the opening 78 in the handle 28, nudging the palm of the user and providing a positive tactile signal that the trocar has penetrated the wall of the body cavity. Thus the user knows when to stop advancing the trocar 20.

As shown in Figure 6, the obturator 34 preferably has a shoulder 84, which engages the distal end 60 of the assembly 46, thereby limiting the proximal movement of the obturator 34.

The user then grasps the fixture 26 of the access tube 22, and pulls the trocar proximally, leaving the access tube in the abdominal wall. As noted above, the access tube preferably has a trap-door valve that closes the cannula 24 when the trocar is withdrawn to prevent the escape of gas from the abdomen. The trocar can be quickly prepared for reuse (on the same patient) by pressing the enlarged end 80 of the cap 62 down through the opening 78, until the beads 56 on the fingers 54 engage the shoulder 64, and the notches 76 on the locking member 68 hold the fingers in place. Another access tube can be placed over the trocar 20, and the procedure repeated.

The trocar 100 is prepared for use by removing the protective cap over the point. The access tube 102 is already installed over the distal end of the trocar 100. The user grasps the handle 126 of the trocar 100, with the palm of the hand over the end. The trocar 100 is advanced against the wall of a body cavity, for example the abdomen. As the trocar 100 is advanced, friction or drag from the skin urges the protective sleeve 142 proximally. The proximal movement of the protective sleeve pushes the locking member 160 proximally, until the cylindrical section 144 displaces the locking member and holds the fingers 156 in engagement with the flange 154. Compare Figures 10 and 12. The trocar is now primed and ready to retract the obturator.

The user continues to advance the trocar until the cannula 104 pierces completely through the wall of the abdomen. At this point, the cannula 104 shields the protective sleeve 142 from frictional contact with the skin, 35 and the protective sleeve begins to advance distally. As the protective sleeve advances distally, the cylindrical section 144 uncovers the fingers 156, which spring resiliently outwardly. When the beads 158 on the fingers 156 clear the flange 154, the obturator 140 begins to retract under the bias of the spring 146. The retraction of the obturator causes the indicator 168 to slide so that the indicia at 172b is exposed in the window 170. Furthermore the cap 152 protrudes through the opening 174 in the handle 126, giving both a visual and tactile signal that the trocar has pierced through the wall of the abdomen, so that further advancement can be halted.

The cannula is then moved to its desired position. The fixture 106 is gripped, and the buttons 138 depressed to release the handle from the fixture. The trocar can then be pulled from the access tube 102. As the trocar is removed from the fixture, the trap door valve member 112 closes the opening 110 to prevent the escape of the gas used to inflate the abdomen. Instruments can be introduced into the abdomen via the access tube 102. Lost gas can be replaced via the Roberts valve 124, excess gas can be vented by pressing pushbutton 116 to open valve member 112.

The trocar 100 can be reset by pressing the end cap 152. This pushes the obturator distally and brings the flange 154 below the beads on the fingers. The locking member 160 is freely slidable with respect to the extension 150 so that when the cap 152 is pressed, the obturator 140 and the extensions 150 move distally relative to the locking member 160 so that the shoulder 154 on the extension 150 is brought into engagement with the fingers 156 before the locking member 160 engages the fingers. Preferably the locking member 160 will frictionally engage some portion of the mechanism, retarding the locking member 160, and facilitating this relative motion. The obturator can over-travel enough that further pushing brings the locking member 160 over the fingers, holding the beads 158 in engagement with the flange 154. The tabs 164 on the locking member 160 engage the portion 166 of the indicator 168 and restore the indicators to their initial positions. The trocar is now ready for installation in another access tube for reuse (on the same patient).

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limited sense.

## Claims

1. A trocar (20) for placement in the lumen of a cannula (24) to facilitate inserting the cannula through the wall of a body cavity, the trocar comprising:

   (a) a handle (28);
   (b) an obturator (34) with a point (36) for piercing the wall of the body cavity;
   (c) a protective sleeve (38) mounted concentrically around said obturator; and characterised by
   (d) a mechanism (42, 54, 56, 64, 66, 68) for retracting said obturator (34) proximally relative to said handle (28) generally simultaneously as said protective sleeve (38) advances distally relative to said handle (28) after said point (36) has penetrated through the wall of the body cavity.

2. A trocar according to claim 1 wherein the protective sleeve (38) advances distally with respect to the obturator (34) after the obturator point penetrates through the wall of the body cavity.

3. The trocar according to claim 2 wherein the protective sleeve (38) can move axially with respect to the obturator (34), and is resiliently biased (42) distally so that the protective sleeve can retract proximally relative to the obturator in response to drag from the wall of the body cavity as the trocar is advanced through the wall of the body cavity, and can advance distally after the cannula has penetrated through the wall of the body cavity and reduced the drag on the sleeve, and further comprising means for triggering (40, 54, 56, 66) the retracting mechanism upon the distal advancement of the protective sleeve.

4. A trocar according to any preceding claim wherein cannula (24) has a distal end, which trocar is adapted to facilitate inserting the cannula through the wall of a body cavity, wherein
   said handle (28) has a housing (30, 32), and the protective sleeve (38) is mounted for movement between a projecting position with the distal end projecting beyond the distal end of the cannula and a retracted position with the distal end of the member being situated closer to the distal end of the cannula than in the projecting position, the obturator retracting proximally relative to the housing in response to the member advancing distally relative to the housing.

5. The trocar according to claim 1 or 4 further comprising means (80) for providing a tactile signal to the user when the obturator (34) retracts, to signal the user that the point (36) has penetrated through the wall of the body cavity.

## Patentansprüche

1. Trokar (20) zur Positionierung in dem Lumen einer Kanüle (24), um die Einführung der Kanüle durch die Wand eines Körperhohlraums zu erleichtern, wobei der Trokar folgendes umfaßt:

   (a) einen Griff (28);
   (b) einen Obturator (34) mit einer Spitze (36) zur Durchdringung der Wand des Körperhohlraums;
   (c) eine Schutzhülle (38), die konzentrisch um den genannten Obturator angebracht ist; und gekennzeichnet durch:
   (d) einen Mechanismus (42, 54, 56, 64, 66, 68) zum proximalen Zurückziehen des genannten Obturators (34) im Verhältnis zu dem genannten Griff (28), und zwar allgemein gleichzeitig zu dem distalen Vorrücken der genannten Schutzhülle (38) im Verhältnis zu dem genannten Griff (28) nachdem die genannte Spitze (36) die Wand des Körperhohlraums durchdrungen hat.

2. Trokar nach Anspruch 1, wobei die genannte Schutzhülle (38) im Verhältnis zu dem Obturator (34) distal nach vorne rückt, nachdem die Obturatorspitze die Wand des Körperhohlraums durchdrungen hat.

3. Trokar nach Anspruch 2, wobei sich die Schutzhülle (38) im Verhältnis zu dem Obturator (34) distal bewegen kann, und wobei die Schutzhülle distal unter Vorbelastung (42) steht, so daß die Schutzhülle im Verhältnis zu dem Obturator zurückgezogen werden kann, und zwar als Reaktion auf das Schleifen an der Wand des Körperhohlraums, wenn der Trokar durch die Wand des Körperhohlraums vorgeschoben wird, und wobei die Schutzhülle distal vorrücken kann, nachdem die Kanüle die Wand des Körperhohlraums durchdrungen und sich das Schleifen an der Hülle verringert hat, und ferner mit einer Einrichtung zum Auslösen (40, 54, 56, 66) des Retraktionsmechanismus nach dem distalen Vorrücken der Schutzhülle.

4. Trokar nach einem der vorstehenden Ansprüche, wobei die Kanüle (24) ein distales Ende aufweist, wobei der Trokar so geformt ist, daß er das Einführen der Kanüle durch die Wand eines Körperhohlraums erleichtert, wobei:
   der genannte Griff (28) ein Gehäuse (30, 32) aufweist, und wobei die genannte Schutzhülle (38) so angebracht ist, daß sie zwischen einer vorstehenden Position, an der das distale Ende über das distale Ende der Kanüle vorsteht, und einer eingezogenen Position beweglich ist, an der sich das distale Ende des Elements näher an dem distalen Ende der Kanüle befindet als an der vorstehenden

Position, wobei der Obturator im Verhältnis zu dem Gehäuse als Reaktion auf das distale Vorrücken des Elements im Verhältnis zu dem Gehäuse proximal zurückgezogen wird.

5. Trokar nach Anspruch 1 oder 4, wobei der Trokar ferner eine Einrichtung (80) umfaßt, die dem Benutzer ein fühlbares Signal zuführt, wenn der Obturator (34) zurückgezogen wird, wodurch dem Benutzer angezeigt werden soll, daß die Spitze (36) die Wand des Körperhohlraums durchdrungen hat.

**Revendications**

1. Trocart (20) pour placement dans la lumière d'une canule (24) pour faciliter l'insertion de la canule à travers la paroi d'une cavité corporelle, le trocart comprenant :

   (a) une poignée (28) ;
   (b) un obturateur (34) avec une pointe (36) pour percer la paroi de la cavité corporelle ;
   (c) un manchon de protection (38) monté de manière concentrique autour dudit obturateur ;
   et caractérisé par :
   (d) un mécanisme (42, 54, 56, 64, 66, 68) pour rétracter, de manière proximale, ledit obturateur (34) par rapport à ladite poignée (28) globalement simultanément lorsque ledit manchon de protection (38) avance, de manière distale, par rapport à ladite poignée (28) après pénétration de ladite pointe (36) à travers la paroi de la cavité corporelle.

2. Trocart selon la revendication 1, dans lequel le manchon de protection (38) avance de manière distale par rapport à l'obturateur (34) après pénétration de ladite pointe d'obturateur à travers la paroi de la cavité corporelle.

3. Trocart selon la revendication 2, dans lequel le manchon de protection (38) peut se déplacer de manière axiale par rapport à l'obturateur (34), et est rappelé élastiquement (42) de manière distale de sorte que le manchon de protection peut se rétracter de manière proximale par rapport à l'obturateur en réponse à la résistance de la paroi de la cavité corporelle lorsque l'on avance le trocart à travers la paroi de la cavité corporelle, et peut avancer de manière distale après pénétration de la canule à travers la paroi de la cavité corporelle et diminution de la résistance sur le manchon, et comprenant, en outre, un moyen pour déclencher (40, 54, 56, 66) le mécanisme de rétraction lors de l'avance distale du manchon de protection.

4. Trocart selon l'une quelconque des revendications précédentes, dans lequel la canule (24) comporte une extrémité distale, lequel trocart est conçu pour faciliter l'insertion de la canule à travers la paroi d'une cavité corporelle, dans lequel :

   ladite poignée (28) comporte un boîtier (30, 32), et le manchon de protection (38) est monté pour se déplacer entre une position en saillie par rapport à l'extrémité distale faisant saillie au-delà de l'extrémité distale de la canule et une position rétractée, l'extrémité distale de l'élément étant située plus près de l'extrémité distale de la canule que dans la position en saillie, l'obturateur se rétractant, de manière proximale, par rapport au boîtier en réponse à l'avance de l'élément, de manière distale, par rapport au boîtier.

5. Trocart selon la revendication 1 ou 4, comprenant, en outre, un moyen (80) pour, lorsque l'obturateur (34) se rétracte, fournir un signal tactile à l'utilisateur, pour informer l'utilisateur que la pointe (36) a pénétré à travers la paroi de la cavité corporelle.

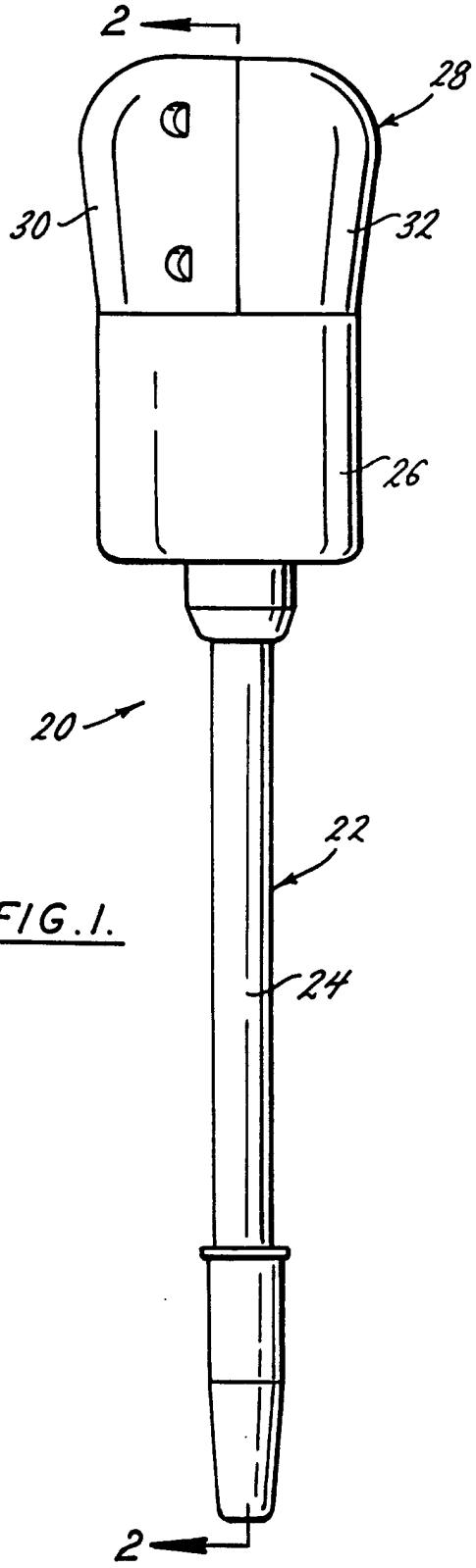


FIG. 1.

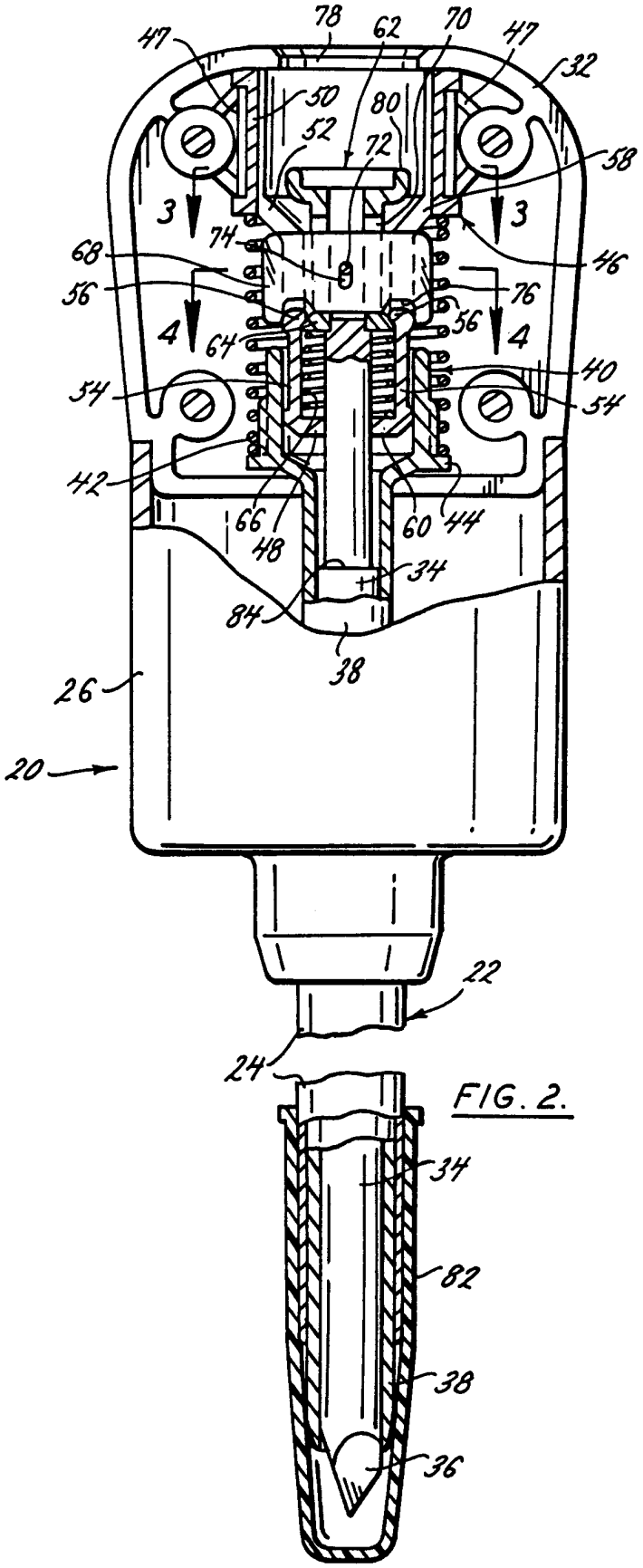
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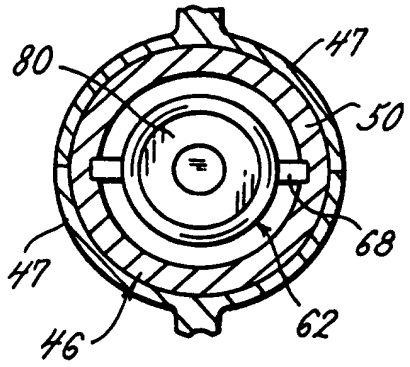
FIG. 2.

FIG. 3.



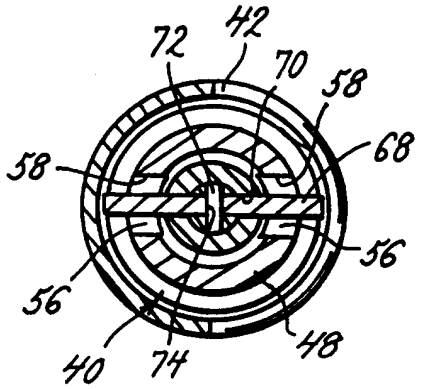
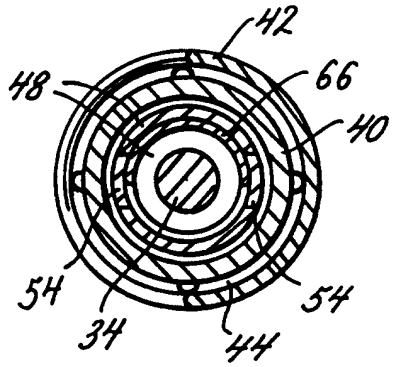




FIG. 4.

FIG. 7.



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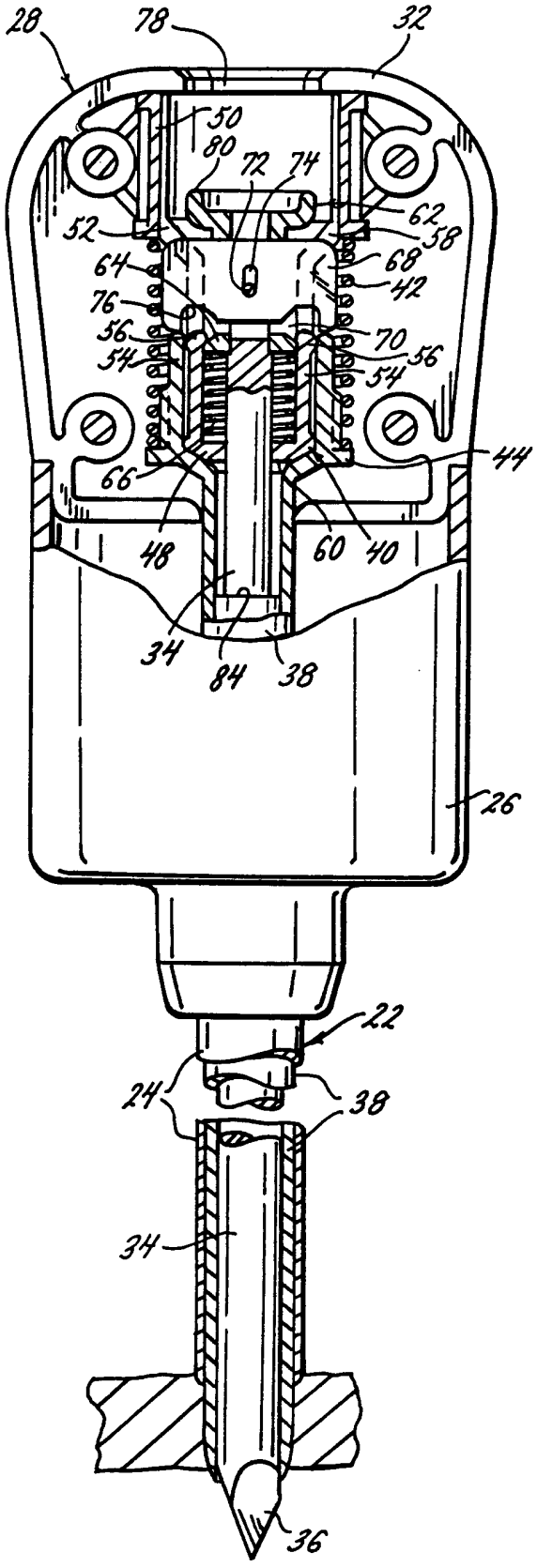
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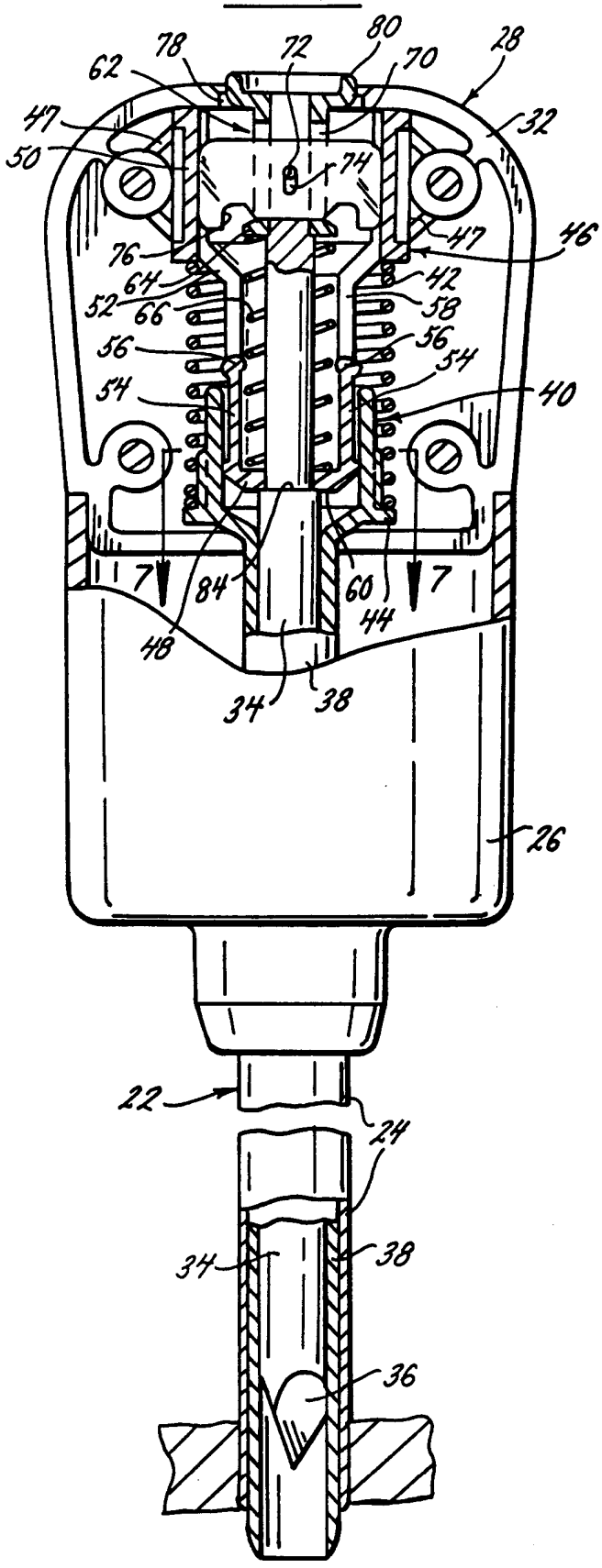
FIG. 6.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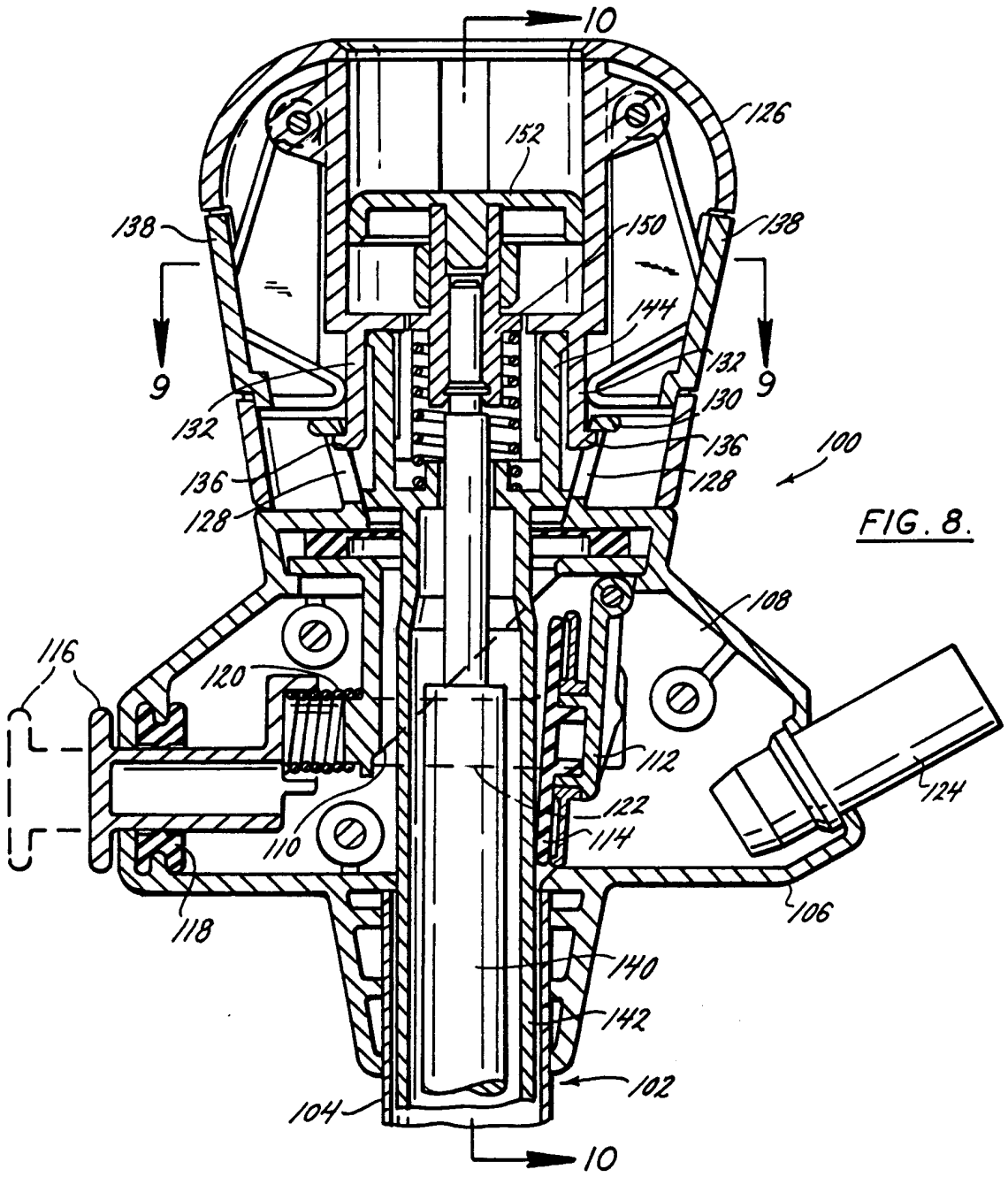
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FIG. 8.

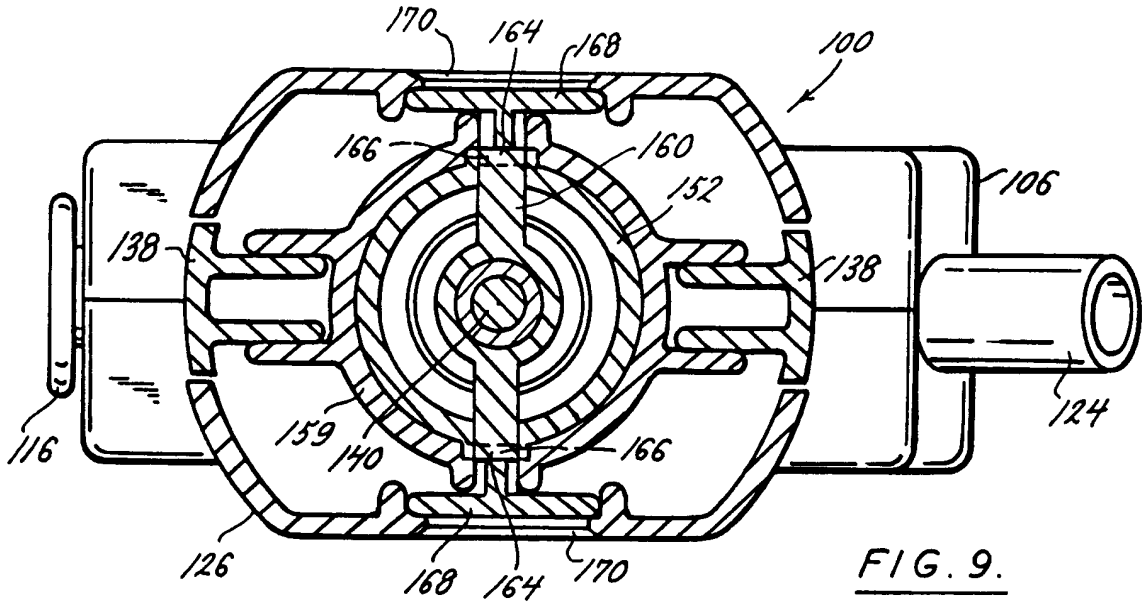
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FIG. 9.

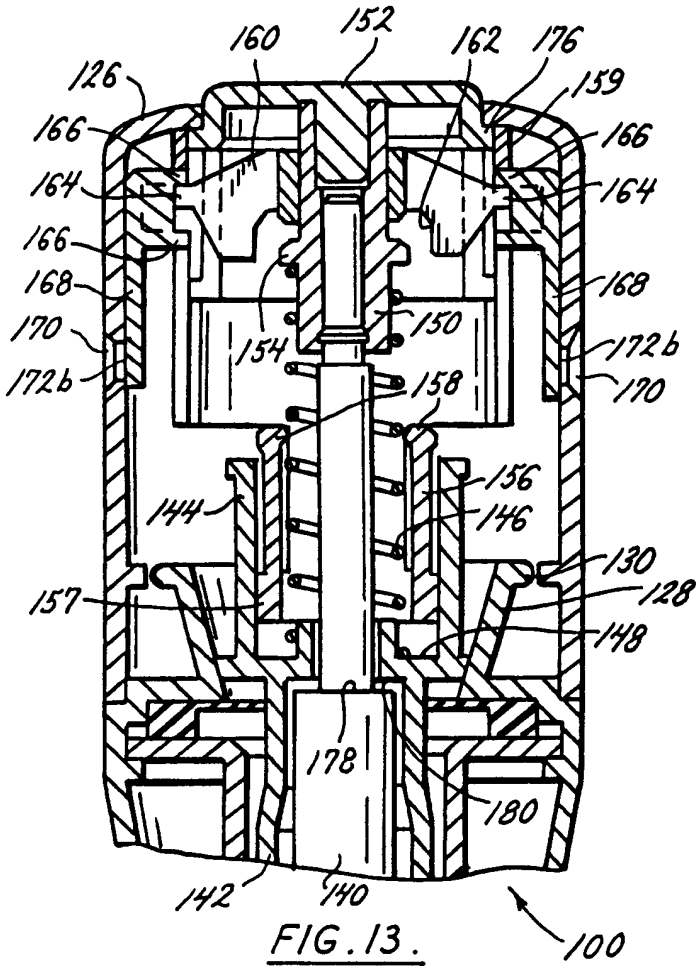
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FIG. 13.

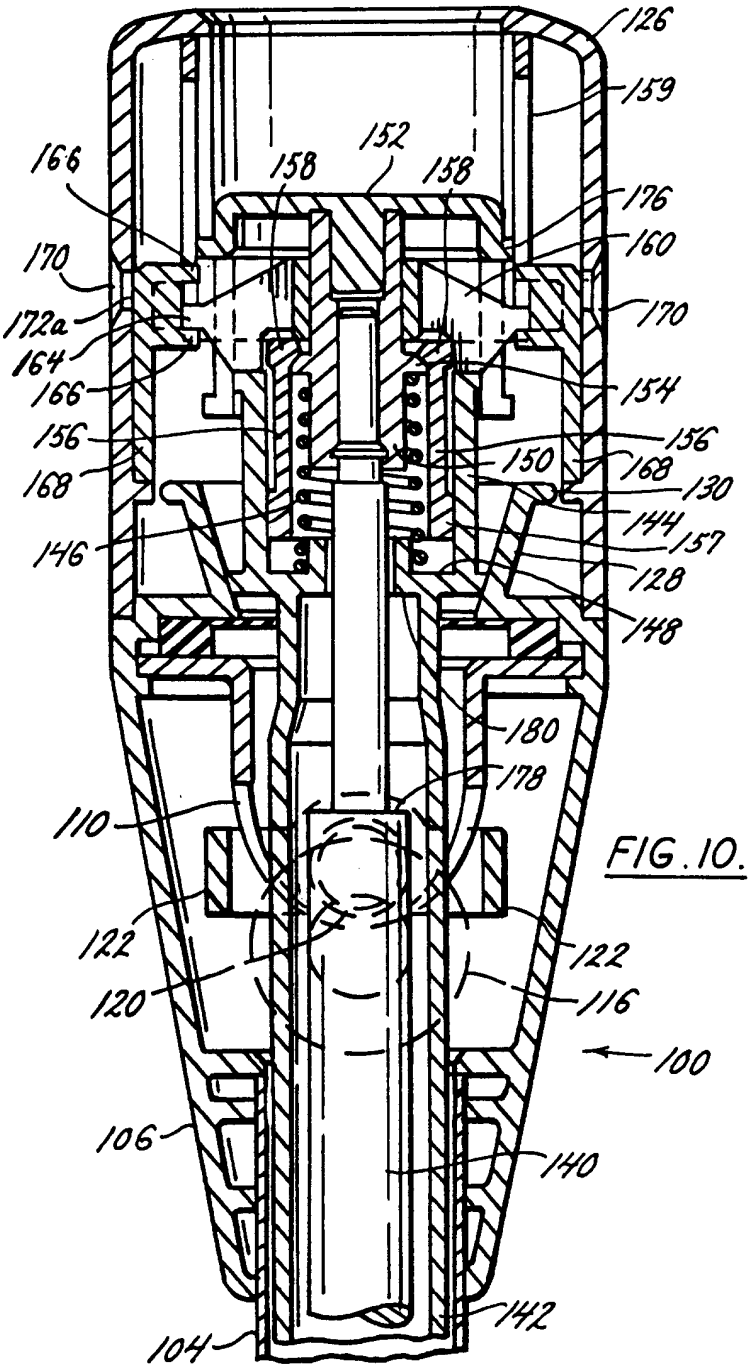
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FIG. 10.

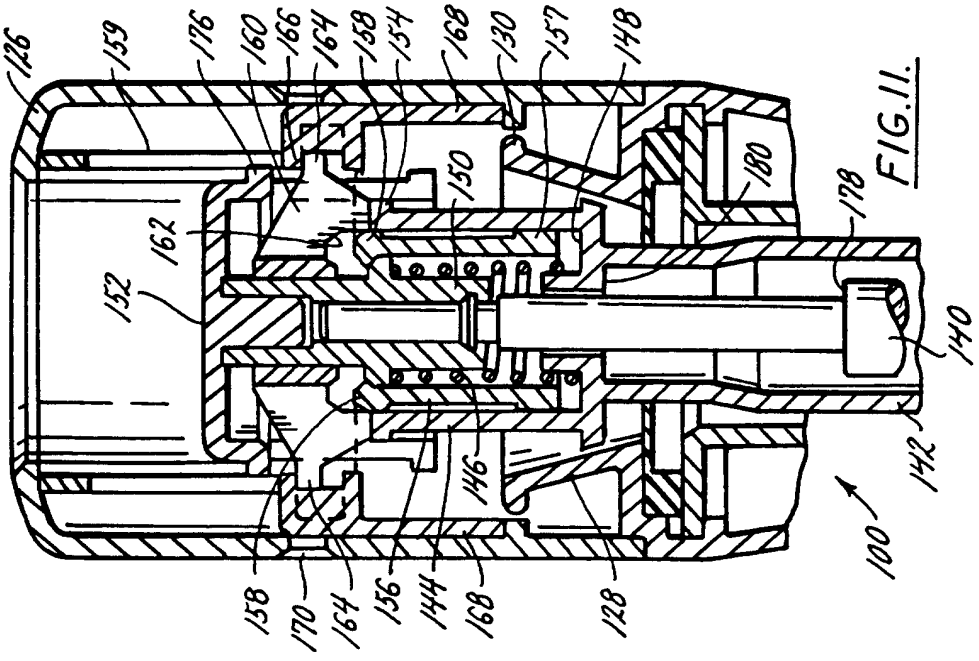
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FIG. 11.

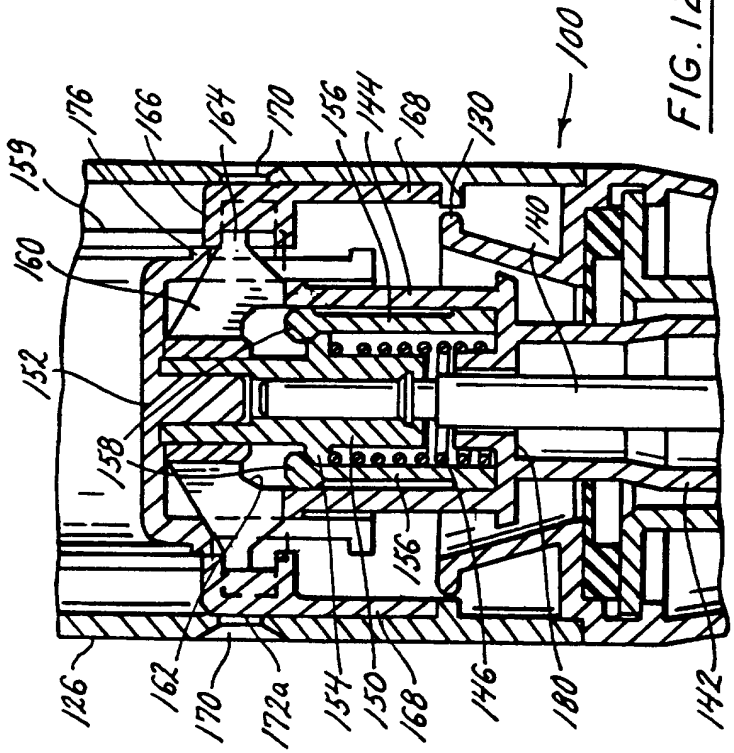
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FIG. 12.